



100 years of ringing in Britain and Ireland

JEREMY J.D. GREENWOOD*

Centre for Research into Ecological and Environmental Modelling, The Observatory, Buchanan Gardens, University of St Andrews, KY16 9LZ and British Trust for Ornithology, The Nunnery, Theford, IP24 2PU

Three ringing schemes started in Britain in 1909. The Witherby scheme persisted, becoming the BTO scheme. At first, the focus was on migration and eventually *The Migration Atlas* set new standards in ring-recovery analysis, developed even further in the Migration Mapping Tool which was stimulated by interest in the spread of avian influenza. Demography was the main focus in the last quarter of the 20th century, with ringing data being combined with those from censuses and nest records. Analyses of great significance for conservation science have been greatly facilitated by the enthusiastic support of ringers for computerisation, and their participation in special projects designed to improve demographic information.

BIRTH, GROWTH AND DEVELOPMENT

Early days

During the closing decades of the 19th century, as the traditionalists mummified in their museums, the new generation of ornithologists focused much of their dynamic energy on bird migration. The direct observation of visible movements was their chief means of investigation but in 1891 a programme of ringing young Woodcock *Scolopax rusticola* was started on the Duke of Northumberland's estates at Alnwick (Percy 1908). The rings were simply inscribed with N and the year, satisfactory enough when all the birds ringed were of the same species, the same age, and in the same place – and where all the birds would be recovered through shooting by a class of people likely to know what was being done at Alnwick. Eight years later, Hans Chr. Mortensen, a Danish schoolteacher, made the key breakthrough by starting a systematic programme of marking birds with individually numbered rings; he publicised his work widely and realised the importance of putting an address on the rings that was full enough that those finding his birds would report them to him (Preuss 2001).

Within a few years, ringing schemes were springing up across Europe and North America. In Britain and Ireland, no fewer than three schemes were set up in 1909. The magazine *Country Life*, having received various reports of ringed birds, set one up but the methods were naive and it folded almost at once (Greenwood & Toomer in prep.). Landsborough Thomson, after a visit to the famous bird observatory at Rossitten (Thomson 1909, 1911) set up another based at Aberdeen University, while in his first undergraduate year; Thomson was clear about the

possibilities and limitations of ringing for the study of migration and the scheme was well organised but it closed in the war (Thomson 1921). For *British Birds* to set up a scheme was almost inevitable, given not only the fervour of interest at the time but also Harry Witherby's stated intent of encouraging cooperative work when he founded the journal in 1907.

The *BB* scheme expanded rapidly with annual ringing totals of nearly 15,000 in 1913 and, after the disruption of war, to almost 50,000 by 1935 (Fig 1). Donations from ringers and, later, charges for rings helped defray some of the costs of the scheme and the administrative burden was largely taken over by Elsie Leach, without pay, in around 1930. The foundation of the BTO in 1933 was another step forward in the development of collaborative ornithology, which Witherby supported with both advice and money.

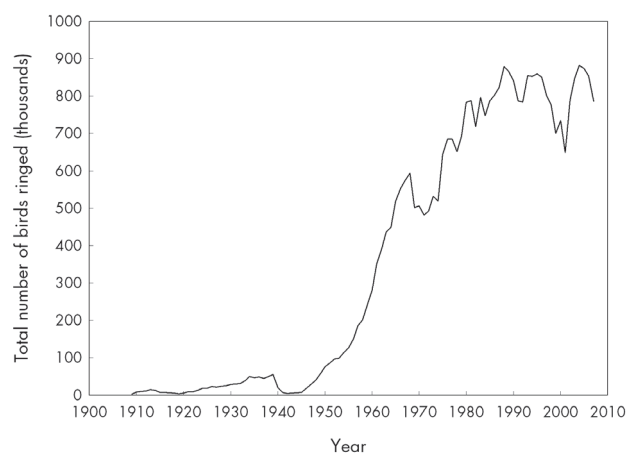


Figure 1. Annual total numbers of birds ringed under the *British Birds* and BTO ringing scheme.

* Email: cynthia.jeremy@tiscali.co.uk

It provided him with an opportunity to hand over the ringing scheme in 1937 to an organisation that could take it forward securely into the future. The BTO had no premises of its own and the little space provided at the London Zoo and in Oxford was insufficient to accommodate the ringing office; however, the British Museum (Natural History) provided a room – and a prestigious address that has been retained down to the present to stimulate recoveries being reported – though the office itself moved to Tring, with the rest of the BTO, in 1963.

The Spencer revolution

When the BTO took over the ringing scheme, it set up a committee to oversee it. Miss Leach served as its Honorary Secretary until 1953 and Landsborough Thomson, not only one of the leading European authorities on ringing and migration but now an experienced administrator (in the Medical Research Council), served as Chairman until 1965. Nonetheless, developments in ringing were slow, for the BTO had no staff, little money and a time- and money-consuming commitment to set up and support an ornithological institute in Oxford. The war and post-war austerity did not make things easier. P.A.D. Hollom's *Trapping Methods for Bird Ringers* had been compiled in 1939 but was not published until much later (Hollom 1950). Even after the BTO's finances improved enough for it to provide funding for the ringing scheme, and the fledgling Nature Conservancy gave the Trust funding which enabled it to employ a young secretary to help in the ringing office, it was difficult to do more than maintain the routine issue of rings, registration of recoveries and production of an annual report. The Conservancy's support was based on its realisation that it could not do its work without scientific evidence and that it needed the help of the amateur naturalists of the country if it were to gather the information it needed. This attitude was strengthened when Max Nicholson, who not only was the chief founder of the BTO but was also much involved in the foundation of the Conservancy, became its second and most influential Director General (Greenwood 2007). As a result, the BTO began to receive more funding and Bob Spencer was appointed as Ringing Officer in 1954.

Over the next few years, there was a revolution in British ringing. Criteria for becoming a ringer and the discipline of ringers were tightened, standards of ringing, identification and data-gathering improved, and a permit system introduced; rings were improved (using measurements of tarsi rather than people's opinions to determine what was the appropriate size for each species); the supply of mist-nets was organised and regulated, their quality and use controlled and a guide to their use published; the *Ringers' Bulletin* was launched in 1957; *The Bird in the Hand* (Cornwallis & Smith 1960) and the first edition of *The*

Ringer's Manual (Spencer 1965) were published; ringers' conferences were organised; the first special ringing enquiry was run (Sand Martins *Riparia riparia*, during 1962–68 – not 1959–65 as stated in some places). All this was against a huge increase in ringing activity (Fig 1). While many others participated, as they have continued to participate, in the further development of ringing, it was Bob who led this revolution.

THE STUDY OF MOVEMENTS

The foundation years

Ring recoveries, at first individually reported in *British Birds* and other journals, soon began to accumulate. By 1926, Landsborough Thomson was able to publish many maps of recoveries and draw conclusions on: how far birds move, in what directions and by what routes; partial migrancy and individual differences; return to the same breeding area (with ducks as a general exception); repeated use of the same winter quarters; and cases of northward dispersal before migration in autumn (Thomson 1926). Five years later, he reported on the discovery of 'abmigration' (Thomson 1931) and Witherby & Leach (1931–32) published a massive review of foreign recoveries, followed by five addenda in the next eight years. David Lack's (1943–44) review of partial migration was based on a substantial body of evidence. More analyses and syntheses were published in other countries (Thomson 1926, 1936).

The mid-century surge

There was a surge of interest in migration after the 1939–45 war. The volume of papers in *British Birds* that were based on ringing through the 1950s, 60s and 70s was about twice pre-war levels, despite the advent of *Bird Study* in 1954, in which about a quarter of the papers in the 1950s and 1960s were about ringing or migration. In response to pressure from the ringers, Ken Williamson was appointed for five years as Migration Research Officer by the BTO. He worked with energy and verve, publishing much of his work in the Trust's new (though short-lived) journal, *Bird Migration*. However, he concentrated on drawing together reports from observatories and similar sources and appears to have collaborated but little with the ringers: there was just one joint paper with Bob Spencer published in *Bird Migration* and that journal carried few other papers based on ring-recovery analyses. After that, BTO interest in migration languished somewhat and it was many years before comprehensive analyses of ring recoveries were published, in the form of the *Migration Atlas* (Wernham *et al* 2002). However, the delay had its advantages, for modern computers allowed much more powerful analyses than would have been possible before. The substantial chapters on Analysis and Interpretation of the

Ring-recovery Data (Wernham & Siriwardena 2002) and on a Synthesis of the Migration Patterns of British & Irish Birds (Siriwardena & Wernham 2002) represent landmarks in the study of migration through ringing.

Dispersal

Long before organised ringing schemes, various people had marked a few birds and demonstrated that some remained faithful to their precise breeding sites (Greenwood in prep.). That this was general, and that young birds tend to be less faithful to their natal areas than adults are to places in which they have already bred, was an early conclusion from 20th century ringing as ringers operated in the same sites in successive years. But, of course, while they found the individuals that did return, ringers did not know whether those that failed to return had dispersed further or had simply died. It took the accumulation of recoveries from the general public to reveal the actual patterns of dispersal, such as the findings from analyses of the British data that dispersal was greater in scarcer and less widely distributed species, in migrants and in wetland birds (Paradis *et al* 1998) and that population changes are more synchronous across the country in species that disperse more widely (Paradis *et al* 2002).

Applications

Like so many areas of ornithology in recent decades, the study of bird movements had its applications to both bird conservation and human welfare. For example, measurements of local dispersal of waders between roost sites on the Wash within single winters have been used to recommend the minimum spacing of refuges (Rehfishch *et al* 1996) and the 2005 outbreak of avian influenza resulted in a surge of sales of the *Migration Atlas* to government agencies, anxious to find out the likelihood of infected birds bringing the disease to Britain and Ireland. To enable the migration routes and the months during which birds were in different places to be more clearly identified, the UK Government Department for Environment, Food and Rural Affairs (DEFRA) supplied funding for the analyses of data to be further refined in a Migration Mapping Tool (Fig 2) and European Union funding allowed the BTO to extend this to a European scale (<http://blx1.bto.org/ai-eu/>). Given that Landsborough Thomson spent most of his professional life as a senior officer of the Medical Research Council, this particular application of the ringing studies that he did so much to promote is particularly appropriate.



Figure 2. Migration route of Wigeon wintering in Britain and Ireland as displayed by the Migration Mapping Tool. Small dots indicate locations of individual recoveries, shading the areas encompassing 50% (dark) and 95% (light) of recoveries. Large dots connected by lines indicate mean location of recoveries for each month (1=Jan, ..., 12=Dec).

BEYOND MOVEMENTS

From the earliest days, ornithologists have recognised that it was not just movements that could be revealed by individual marking (Witherby 1909, Thomson 1921, Rydzewski 1951). Thus as soon as ringing became widespread it was used to determine whether species were, at least sometimes, double-brooded (Ticehurst 1913) and the BTO's Moulting Enquiry, launched in 1960 and both supported by and feeding into two BTO Guides to moulting (Snow 1967, Ginn & Melville 1983), was anticipated by over a century in J.A. Naumann's (unsuccessful) attempt to establish plumage sequences in Buzzards *Buteo buteo* through ringing birds of known age (Bub & Oelke 1989).

In the 1920s, the Irish civil engineer J.P. Burkitt became the first person in the world to use ringing to study a population in terms of its individual members (Nelson & Haffer 2009). Though this work was ignored by the reactionary ornithological establishment, it was an inspiration for Mrs M.M. Nice's later work in Ohio (Nice 1937) which in turn laid the foundations of later studies of population biology and social behaviour. It also established the technique of marking birds in such a way that they could be individually identified without being recaptured, though Burkitt used combinations of up to four dark and light rings of different widths rather than colour rings, which he found difficult to distinguish, being red-green colour-blind.

DEMOGRAPHY

Laying the foundations

Another of Burkitt's innovations was to estimate mean life-spans of his marked birds. Lack (1943a, b) extended this idea by estimating survival rates from the recoveries in the entire ringing scheme, a method put on a more powerful and more secure statistical footing by Haldane (1955). This laid the foundations for the use of BTO data in population studies, the potential of which was shown by the BTO's first Director of Science, David Snow, with a paper in the prestigious journal *Nature* based on ringing and nest records data for Blackbirds *Turdus merula* (Snow 1966). He pointed out that the newly established Common Birds Census (CBC) would eventually reveal changes in population size. Four years later, the Trust's next Director, Jim Flegg, pointed out clearly that "The 'population equation' ... can be stated in simplified form as

$$\text{mortality} + \text{recruitment} = \text{population change}$$

The Trust alone possesses the fundamental capacity to make this assessment – mortality from Ringing, recruitment from Nest Records and population change from... the Common Birds Census" (Flegg 1970).

Computers

Despite these pointers, progress remained slow, especially in the analysis of mortality, partly because the necessary calculations were tedious in those pre-computer days. When Flegg arrived, the Trust had one manual calculating machine; he persuaded Council to invest in electric (not electronic) calculators and later a card-punch machine, the latter allowing data to be prepared for analysis on computers belonging to other bodies. This laid the foundation for the Trust getting its own computer in 1979, allowing the next Director, Raymond O'Connor, to push computerisation onward during the next decade. Recovery processing moved in-house and in the early 1980s the Trust received a grant from EURING to computerise all past recoveries of BTO-ringed birds.

Computers were by now beginning to appear in people's homes. In *Ringers' Bulletin* in 1982 Chris Mead, ever visionary, contemplated the possibility of ringers being able to submit data on disc. At the next Ringers' Conference, an informal meeting of about 60 agreed on a coding system (little changed today) and in 1984 a volunteer group of ringers, with the support of Chris Mead and Stephen Baillie, started to produce B-RING for BBC Microcomputers. It was released in 1986, with a PC version three years later.

In the 75th anniversary issue of *Ringling & Migration*, ringer Mike Boddy saw computerisation as the chief development for ringing (Boddy 1984); he and O'Connor (1984) raised the desirability of collecting more biometric and similar data (more readily usable in the computer age); and Mead (1984) speculated that ringers might eventually be able to submit data down telephone lines. B-RING was released. However, at first B-RING merely enabled ringers to process their own data more effectively: data submission on disc did not start until 1997. From then on, particularly following the release of the more powerful package IPMR in 2000, computer submissions grew apace and almost all data are now submitted electronically; many ringers have also computerised their past data.

Taking demography forward

Computers are only a means to an end. Another of O'Connor's key contributions was his paper on the Great Tit *Parus major* (O'Connor 1980), showing how BTO data, based on amateurs' fieldwork, could produce demographic results comparable to those of intensive professional studies – indeed, that they could deliver quite novel results.

From the 1970s onwards, statisticians have been developing ever more powerful methods for estimating mortality rates using both recoveries of dead birds and observations of live ones (retraps, controls and resightings) (see Schwarz & Seber 1999, Buckland *et al* 2000). BTO staff have not just been users of these methods but have actively

participated in their development, with the paper by Mead *et al* (1979) and two co-authored for the first EURING Technical Conference (Baillie & Green 1987, Buckland & Baillie 1987) marking the start of that involvement.

Integrated Population Monitoring

In the last 20 years, the BTO has made two world-leading contributions to conservation biology – its work on declining farmland birds and its development of Integrated Population Monitoring (IPM). The latter was formalised and strategically developed by Stephen Baillie, who publicly announced it at a British Ornithologists' Union Conference in spring 1989 (Baillie 1990), illustrating it with an analysis of Song Thrush *Turdus philomelos* data from the CBC, nest records and ringing. He set out the aims of the programme as:

1. To establish thresholds that will be used to notify conservation bodies of requirements for further research or conservation action.
2. To identify the stage of the life cycle at which changes are taking place.
3. To provide data that will assist in identifying the causes of population changes.
4. To distinguish anthropogenic changes in populations from 'natural' population fluctuations.

IPM is now established as a key element in British bird conservation, though still developing and improving. Its routine results are reported annually on the BTO website under the title Breeding Birds in the Wider Countryside: their conservation status (www.bto.org/birdtrends: Baillie *et al* 2009a). It has been a powerful tool in understanding the decline of farmland birds (eg Siriwardena *et al* 1999, 2000, Gregory *et al* 2004) and the impact of meteorological conditions and thus, potentially, of climate change on bird populations (Robinson *et al* 2007).

The simple approach to IPM analyses is to estimate the demographic variables (numbers, recruitment, survival) separately from the various data sets. More recently, BTO has been involved with others in developing new approaches, based on both conceptual and computing advances, in which the data are brought together into an integrated statistical model and the variables are all estimated simultaneously (Brooks *et al* 2008, Baillie *et al* 2009b). This allows both more precise estimation of the variables and more refined comparison of alternative models.

Constant Effort Sites (CES)

For ringers themselves, the key changes associated with the use of ringing for demographic monitoring have been in data recording (Age-Specific Totals and computer-based submission of data) and field methods (CES and Retrapping Adults for Survival: RAS). One of the pioneers

of constant-effort ringing, Mike Boddy, launched a trial of the CES scheme in 1981, after some years in which he and others had run individual sites. There were doubts as to the value of the scheme but by 1985 it was clear that it could provide information not otherwise available: on numbers for some habitats and species not covered by the CBC; on productivity over the whole season, from juvenile:adult ratios in late summer (nest records cannot monitor the number of broods produced); and on adult survival. That December, BTO Council took CES on as a permanent part of the ringing scheme, run by staff. The target of 100 sites was reached in 1989, and a peak of 142 was achieved in 2000 (before being cut back by foot-and-mouth restrictions in 2001).

Retrapping Adults for Survival

In 1995, a major workshop was held over two days to consider the conservation uses of ringing data (Baillie *et al* 1999a). It led to a scientific strategy being drawn up (Baillie *et al* 1999b), one component of which was the RAS scheme, aimed at producing better data on survival by encouraging intensive studies of single species at fixed sites. Despite the exacting requirements, 120 studies of 45 species were registered in the first year (1998); 10 years later, 80 more studies and 10 more species had been added. Because many ringers had been conducting such studies independently, this has meant that a wealth of historic data has also been fed into the scheme.

Sufficient data have now accumulated to allow useful analyses, such as that of hirundines, which showed that their annual survival depends on rainfall on their various wintering grounds (Robinson *et al* 2008). As so often with BTO work, this result is more significant than if it had emerged from an intensive study of a single site, as generally characterises purely professional work, because it is based on several sites spread across the country.

THE FUTURE

Interesting as it is in its own right, the past is only really important as the key to the future: where are we going and where should we be going? Others better qualified than I consider the future in this issue but here are my own brief thoughts.

The most precious feature of our ringing-based work is that it is based on collaboration: collaboration between amateurs and professionals; collaboration between ringers, other ornithologists and statisticians; and collaboration on large-scale projects such as the Sand Martin Enquiry, CES and RAS. It is essential that this is nurtured at least as strongly in the future as in the past. Developing technology will make it ever easier.

The British and Irish Ringing Scheme has strength in depth because, unlike in many other countries, ringers are not constrained to work on formal projects or particular species. This allows them to grasp opportunities and to innovate; it allows the scheme to recruit large numbers of enthusiastic participants who cover much of the cost; and gives the scheme the flexibility that has allowed it to be highly productive of useful science. Ringers' freedom is another precious asset that should be maintained.

Despite a century of effort, our knowledge of the wintering grounds and migration routes of many species is still poor. The BTO is developing its capacity to work overseas. Ringing must play its part. Local movements, including both dispersal between years and the daily movements of birds in search of food and safe roosting sites, need much more attention. Such work would benefit much from being taken on by local ringing groups. These have already proved their worth in terms of scientific contributions and the spread of expertise; it would be good to see group work expanded further.

The future of ringing is in the hands of each of us ringers. Our ability to achieve the potential of our work depends partly on funding for its central organisation. The BTO has been successful in raising greater funds for its work; I see no reason to doubt that will continue. However, governments are likely to continue to be a major source of funds for work relevant to conservation and only if there is sustained public pressure will those funds be found. Individual ringers themselves can contribute to that pressure. So, after we have had a day in the field and have entered our data into IPMR there is still one more thing we need to do – periodically spend some time putting pressure on our political representative about the importance of conservation and the essential role played by scientific studies.

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